```
=> s lda and pfl and acka
L3            0 LDA AND PFL AND ACKA

=>  s lactate (w) dehydrogenase and acetate (w) kinase and pyruvate (w) formate
L4           39 LACTATE (W) DEHYDROGENASE AND ACETATE (W) KINASE AND PYRUVATE
                (W) FORMATE

=> s l4 and succinic
L5           17 L4 AND SUCCINIC

=> d ibib abs l5 1-14

L5   ANSWER 1 OF 17     MEDLINE on STN
ACCESSION NUMBER:    2002184197     MEDLINE
DOCUMENT NUMBER:     PubMed ID: 11916689
TITLE:               Effects of growth mode and pyruvate carboxylase on
                     succinic acid production by metabolically
                     engineered strains of Escherichia coli.
AUTHOR:              Vemuri G N; Eiteman M A; Altman E
CORPORATE SOURCE:    Center for Molecular BioEngineering, Department of
                     Biological and Agricultural Engineering, University of
                     Georgia, Athens, Georgia 30602, USA.
SOURCE:              Applied and environmental microbiology, (2002 Apr) Vol. 68,
                     No. 4, pp. 1715-27.
                     Journal code: 7605801. ISSN: 0099-2240.
PUB. COUNTRY:        United States
DOCUMENT TYPE:       Journal; Article; (JOURNAL ARTICLE)
                     (RESEARCH SUPPORT, NON-U.S. GOV'T)
LANGUAGE:            English
FILE SEGMENT:        Priority Journals
ENTRY MONTH:         200207
ENTRY DATE:          Entered STN: 3 Apr 2002
                     Last Updated on STN: 13 Jul 2002
                     Entered Medline: 12 Jul 2002
AB   Escherichia coli NZN111, which lacks activities for pyruvate-
     formate lyase and lactate dehydrogenase, and
     AFP111, a derivative which contains an additional mutation in ptsG (a gene
     encoding an enzyme of the glucose phophotransferase system), accumulate
     significant levels of succinic acid (succinate) under anaerobic
     conditions.  Plasmid pTrc99A-pyc, which expresses the Rhizobium etli
     pyruvate carboxylase enzyme, was introduced into both strains.  We
     compared growth, substrate consumption, product formation, and activities
     of seven key enzymes (acetate kinase, fumarate
     reductase, glucokinase, isocitrate dehydrogenase, isocitrate lyase,
     phosphoenolpyruvate carboxylase, and pyruvate carboxylase) from glucose
     for NZN111, NZN111/pTrc99A-pyc, AFP111, and AFP111/pTrc99A-pyc under both
     exclusively anaerobic and dual-phase conditions (an aerobic growth phase
     followed by an anaerobic production phase).  The highest succinate mass
     yield was attained with AFP111/pTrc99A-pyc under dual-phase conditions
     with low pyruvate carboxylase activity.  Dual-phase conditions led to
     significant isocitrate lyase activity in both NZN111 and AFP111, while
     under exclusively anaerobic conditions, an absence of isocitrate lyase
     activity resulted in significant pyruvate accumulation.  Enzyme assays
     indicated that under dual-phase conditions, carbon flows not only through
     the reductive arm of the tricarboxylic acid cycle for succinate generation
     but also through the glyoxylate shunt and thus provides the cells with
     metabolic flexibility in the formation of succinate.  Significant
     glucokinase activity in AFP111 compared to NZN111 similarly permits
     increased metabolic flexibility of AFP111.  The differences between the
     strains and the benefit of pyruvate carboxylase under both exclusively
     anaerobic and dual-phase conditions are discussed in light of the cellular
     constraint for a redox balance.
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L5 ANSWER 2 OF 17 BIOSIS COPYRIGHT (c) 2007 The Thomson Corporation on STN
ACCESSION NUMBER: 2002:283873 BIOSIS
DOCUMENT NUMBER: PREV200200283873
TITLE: Effects of growth mode and pyruvate carboxylase on succinic acid production by metabolically engineered strains of Escherichia coli.
AUTHOR(S): Vemuri, G. N.; Eiteman, M. A. [Reprint author]; Altman, E.
CORPORATE SOURCE: CMBE, Department of Biological and Agricultural Engineering, University of Georgia, Athens, GA, 30602, USA eiteman@engr.uga.edu
SOURCE: Applied and Environmental Microbiology, (April, 2002) Vol. 68, No. 4, pp. 1715-1727. print.
CODEN: AEMIDF. ISSN: 0099-2240.
DOCUMENT TYPE: Article
LANGUAGE: English
ENTRY DATE: Entered STN: 8 May 2002
Last Updated on STN: 8 May 2002
AB Escherichia coli NZN111, which lacks activities for pyruvate-formate lyase and lactate dehydrogenase, and AFP111, a derivative which contains an additional mutation in ptsG (a gene encoding an enzyme of the glucose phophotransferase system), accumulate significant levels of succinic acid (succinate) under anaerobic conditions. Plasmid pTrc99A-pyc, which expresses the Rhizobium etli pyruvate carboxylase enzyme, was introduced into both strains. We compared growth, substrate consumption, product formation, and activities of seven key enzymes (acetate kinase, fumarate reductase, glucokinase, isocitrate dehydrogenase, isocitrate lyase, phosphoenolpyruvate carboxylase, and pyruvate carboxylase) from glucose for NZN111, NZN111/pTrc99A-pyc, AFP111, and AFP111/pTrc99A-pyc under both exclusively anaerobic and dual-phase conditions (an aerobic growth phase followed by an anaerobic production phase). The highest succinate mass yield was attained with AFP111/pTrc99A-pyc under dual-phase conditions with low pyruvate carboxylase activity. Dual-phase conditions led to significant isocitrate lyase activity in both NZN111 and AFP111, while under exclusively anaerobic conditions, an absence of isocitrate lyase activity resulted in significant pyruvate accumulation. Enzyme assays indicated that under dual-phase conditions, carbon flows not only through the reductive arm of the tricarboxylic acid cycle for succinate generation but also through the glyoxylate shunt and thus provides the cells with metabolic flexibility in the formation of succinate. Significant glucokinase activity in AFP111 compared to NZN111 similarly permits increased metabolic flexibility of AFP111. The differences between the strains and the benefit of pyruvate carboxylase under both exclusively anaerobic and dual-phase conditions are discussed in light of the cellular constraint for a redox balance.

L5 ANSWER 3 OF 17 CAPLUS COPYRIGHT 2007 ACS on STN
ACCESSION NUMBER: 2006:777227 CAPLUS
DOCUMENT NUMBER: 146:224482
TITLE: Formation of succinic acid by Klebsiella pneumoniae MCM B-325 under aerobic and anaerobic conditions
AUTHOR(S): Thakker, Chandresh; Bhosale, Suresh; Ranade, Dilip
CORPORATE SOURCE: Microbial Science Division, Agharkar Research Institute, Pune, 411 004, India
SOURCE: Journal of Microbiology and Biotechnology (2006), 16(6), 870-879
CODEN: JOMBES; ISSN: 1017-7825
PUBLISHER: Korean Society for Microbiology and Biotechnology
DOCUMENT TYPE: Journal
LANGUAGE: English
AB The present study describes the formation of succinic acid by a nonvirulent, highly osmotolerant Klebsiella pneumoniae strain SAP (succinic acid producer), its profile of metabolites, and enzymes

of the succinate production pathway. The strain produced succinate along with other metabolites such as lactate, acetate, and ethanol under aerobic as well as anaerobic growth conditions. The yield of succinate was higher in the presence of MgCO3 under N2 atmosphere as compared with that under CO2 atmosphere. Anal. of intracellular metabolites showed the presence of a smaller PEP pool than that of pyruvate. Oxaloacetate, citrate, and α-ketoglutarate pools were considerably larger than those of isocitrate and fumarate. In order to understand the synthesis of succinate, the enzymes involved in end-product formation were studied. Levels of phosphoenolpyruvate carboxykinase, fumarate reductase, pyruvate kinase, and acetate kinase were higher under anaerobic growth conditions. Based on the profiles of the metabolites and enzymes, it was concluded that the synthesis of succinate took place via oxaloacetate, malate, and fumarate in the strain under anaerobic growth conditions. The strain SAP showed potential for the bioconversion of fumarate to succinate under N2 atmosphere in the presence of MgCO3. At an initial fumarate concentration of 10 g/l, 7.1 g/l fumarate was converted to 7 g/l
succinate with a molar conversion efficiency of 97.3%. The conversion efficiency and succinate yield were increased in the presence of glucose. Cells grown on fumarate contained an 18-fold higher fumarate reductase activity as compared with the activity obtained when grown on glucose.
REFERENCE COUNT: 31 THERE ARE 31 CITED REFERENCES AVAILABLE FOR THIS RECORD. ALL CITATIONS AVAILABLE IN THE RE FORMAT

L5 ANSWER 4 OF 17 CAPLUS COPYRIGHT 2007 ACS on STN
ACCESSION NUMBER: 2006:635378 CAPLUS
DOCUMENT NUMBER: 145:82087
TITLE: Simultaneous anaerobic production of isoamyl acetate and succinic acid by engineered Escherichia coli
INVENTOR(S): San, Ka-Yiu; Sanchez, Ailen; Bennett, George, N.; Dittrich, Cheryl, Renee
PATENT ASSIGNEE(S): Rice University, USA
SOURCE: PCT Int. Appl., 25 pp.
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: English
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2006069174	A2	20060629	WO 2005-US46425	20051222
WO 2006069174	A3	20061214		
W: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW				
RW: AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR, BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG, BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW, AM, AZ, BY, KG, KZ, MD, RU, TJ, TM				
US 2006141594	A1	20060629	US 2005-315453	20051222
PRIORITY APPLN. INFO.:			US 2004-638765P	P 20041222

AB In vivo method of producing esters from acetyl CoA, such as isoamyl acetate and succinate, has been developed by producing null mutants in pathways that use acetyl CoA and by overexpressing products that use NADH and in order to maintain the proper redox balance between NADH and NAD. The method is exemplified with null mutations in ldhA, adhE, ackA pta and

overexpression of pyruvate carboxylase and alc. acetyltransferase. This strain produces higher levels of both isoamyl acetate and succinate.

L5 ANSWER 5 OF 17 CAPLUS COPYRIGHT 2007 ACS on STN
ACCESSION NUMBER: 2006:354531 CAPLUS
DOCUMENT NUMBER: 144:487271
TITLE: Genome-based metabolic engineering of Mannheimia succiniciproducens for succinic acid production
AUTHOR(S): Lee, Sang Jun; Song, Hyohak; Lee, Sang Yup
CORPORATE SOURCE: Metabolic and Biomolecular Engineering National Research Laboratory, Department of Chemical and Biomolecular Engineering, Korea Advanced Institute of Science and Technology, Daejeon, 305-701, S. Korea
SOURCE: Applied and Environmental Microbiology (2006), 72(3), 1939-1948
CODEN: AEMIDF; ISSN: 0099-2240
PUBLISHER: American Society for Microbiology
DOCUMENT TYPE: Journal
LANGUAGE: English
AB Succinic acid is a four-carbon dicarboxylic acid produced as one of the fermentation products of anaerobic metabolism Based on the complete genome sequence of a capnophilic succinic acid-producing rumen bacterium, Mannheimia succiniciproducens, gene knockout studies were carried out to understand its anaerobic fermentative metabolism and consequently to develop a metabolically engineered strain capable of producing succinic acid without byproduct formation. Among three different CO2-fixing metabolic reactions catalyzed by phosphoenolpyruvate (PEP) carboxykinase, PEP carboxylase, and malic enzyme, PEP carboxykinase was the most important for the anaerobic growth of M. succiniciproducens and succinic acid production Oxaloacetate formed by carboxylation of PEP was found to be converted to succinic acid by three sequential reactions catalyzed by malate dehydrogenase, fumarase, and fumarate reductase. Major metabolic pathways leading to byproduct formation were successfully removed by disrupting the ldhA, pflB, pta, and ackA genes. This metabolically engineered LPK7 strain was able to produce 13.4 g/L of succinic acid from 20 g/L glucose with little or no formation of acetic, formic, and lactic acids, resulting in a succinic acid yield of 0.97 mol succinic acid per mol glucose. Fed-batch culture of M. succiniciproducens LPK7 with intermittent glucose feeding allowed the production of 52.4 g/L of succinic acid, with a succinic acid yield of 1.16 mol succinic acid per mol glucose and a succinic acid productivity of 1.8 g/L/h, which should be useful for industrial production of succinic acid.
REFERENCE COUNT: 37 THERE ARE 37 CITED REFERENCES AVAILABLE FOR THIS RECORD. ALL CITATIONS AVAILABLE IN THE RE FORMAT

L5 ANSWER 6 OF 17 CAPLUS COPYRIGHT 2007 ACS on STN
ACCESSION NUMBER: 2006:298119 CAPLUS
DOCUMENT NUMBER: 144:329918
TITLE: Genetically engineered Escherichia coli for succinate production
INVENTOR(S): San, Ka-Yiu; Bennett, George N.; Lin, Henry; Sanchez, Ailen
PATENT ASSIGNEE(S): Rice University, USA
SOURCE: PCT Int. Appl., 21 pp.
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: English
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2006034156	A2	20060330	WO 2005-US33408	20050916
WO 2006034156	A3	20060824		
W: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW				
RW: AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR, BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG, BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW, AM, AZ, BY, KG, KZ, MD, RU, TJ, TM				
AU 2003200046	B1	20040708	AU 2003-200046	20030103
US 2006073577	A1	20060406	US 2005-228830	20050916
EP 1789569	A2	20070530	EP 2005-812424	20050916
R: AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LI, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR				
PRIORITY APPLN. INFO.:			US 2004-610750P	P 20040917
			WO 2005-US33408	W 20050916

AB The invention relates to a hybrid succinate production system that has a high capacity to produce succinate under aerobic and anaerobic conditions. The metabolic engineering of a hybrid bacterial succinate production system that can function under both aerobic and anaerobic conditions makes the production process more efficient, and the process control and optimization less difficult.

L5 ANSWER 7 OF 17 CAPLUS COPYRIGHT 2007 ACS on STN
ACCESSION NUMBER: 2006:192311 CAPLUS
DOCUMENT NUMBER: 144:252807
TITLE: Mutant Escherichia coli strain with increased succinic acid production
INVENTOR(S): Ka-Yiu, San; Bennett, George N.; Sanchez, Ailen
PATENT ASSIGNEE(S): Rice University, USA
SOURCE: U.S. Pat. Appl. Publ., 15 pp.
CODEN: USXXCO
DOCUMENT TYPE: Patent
LANGUAGE: English
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
US 2006046288	A1	20060302	US 2005-214309	20050829
US 7223567	B2	20070529		
WO 2006031424	A2	20060323	WO 2005-US30689	20050829
WO 2006031424	A3	20061130		
W: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW				
RW: AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR, BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG, BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW, AM, AZ, BY, KG, KZ, MD, RU, TJ, TM				
EP 1781797	A2	20070509	EP 2005-809068	20050829
R: AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE,				

IS, IT, LI, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR, AL, BA, HR, MK, YU

PRIORITY APPLN. INFO.: US 2004-604922P P 20040827
WO 2005-US30689 W 20050829

OTHER SOURCE(S): CASREACT 144:252807

AB The invention relates to a mutant strain of bacteria, which either lacks or contains mutant genes for several key metabolic enzymes, and which produces high amts. of succinic acid under anaerobic conditions.

REFERENCE COUNT: 73 THERE ARE 73 CITED REFERENCES AVAILABLE FOR THIS RECORD. ALL CITATIONS AVAILABLE IN THE RE FORMAT

L5 ANSWER 8 OF 17 CAPLUS COPYRIGHT 2007 ACS on STN

ACCESSION NUMBER: 2005:1026837 CAPLUS
DOCUMENT NUMBER: 143:324903
TITLE: Novel Bacillus strains for the production of chemicals from lignocellulose, biomass or sugars
INVENTOR(S): Shanmugam, Keelnatham T.; O'Neal Ingram, Lonnie; Patel, Milind A.; Ou, Mark S.; Harbrucker, Roberta
PATENT ASSIGNEE(S): University of Florida Research Foundation, Inc., USA
SOURCE: PCT Int. Appl., 188 pp.
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: English
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2005086670	A2	20050922	WO 2005-US6774	20050302
WO 2005086670	A3	20070315		
W: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW, US				
RW: BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW, AM, AZ, BY, KG, KZ, MD, RU, TJ, TM, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR, BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG				
US 2005250192	A1	20051110	US 2004-793568	20040304
US 7098009	B2	20060829		

PRIORITY APPLN. INFO.: US 2004-793568 A1 20040304

OTHER SOURCE(S): CASREACT 143:324903

AB The subject invention relates to newly isolated organisms from nature that produce L(+)-lactic acid at high yield from hexose and pentose sugars found in biomass. Organisms and processes or methods for the production of lactic acid and other industrially important chems. from cellulose and hemicellulose are also provided.

L5 ANSWER 9 OF 17 CAPLUS COPYRIGHT 2007 ACS on STN

ACCESSION NUMBER: 2005:493682 CAPLUS
DOCUMENT NUMBER: 143:21000
TITLE: Genetic engineered novel rumen bacteria variants for preparing succinic acid at high concentration while producing little or no organic acids
INVENTOR(S): Lee, Sang Yup; Lee, Sang Jun
PATENT ASSIGNEE(S): Korea Advanced Institute of Science and Technology, S. Korea
SOURCE: PCT Int. Appl., 59 pp.
CODEN: PIXXD2
DOCUMENT TYPE: Patent

LANGUAGE: English
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2005052135	A1	20050609	WO 2004-KR1210	20040520
W: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW				
RW: BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW, AM, AZ, BY, KG, KZ, MD, RU, TJ, TM, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR, BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG				
KR 2005051186	A	20050601	KR 2003-84934	20031127
KR 2005102827	A	20051027	KR 2004-28105	20040423
AU 2004292642	A1	20050609	AU 2004-292642	20040520
CA 2545363	A1	20050609	CA 2004-2545363	20040520
EP 1692271	A1	20060823	EP 2004-734158	20040520
R: AT, BE, CH, DE, DK, ES, FR, GB, GR, IT, LI, LU, NL, SE, MC, PT, IE, SI, FI, RO, CY, TR, BG, CZ, EE, HU, PL, SK				
CN 1910273	A	20070207	CN 2004-80034984	20040520
BR 2004016437	A	20070221	BR 2004-16437	20040520
JP 2007512015	T	20070517	JP 2006-541014	20040520
IN 2006CN01865	A	20070223	IN 2006-CN1865	20060526
US 2007054387	A1	20070308	US 2006-580556	20060526
KR 2006070525	A	20060623	KR 2006-51771	20060609

PRIORITY APPLN. INFO.:

KR 2003-84934	A	20031127
KR 2004-28105	A	20040423
WO 2004-KR1210	W	20040520

AB The present invention relates to novel rumen bacterial mutants resulted from the disruption of a lactate dehydrogenase gene (ldhA) and a pyruvate formate-lyase gene (pfl), which are involved in the production of lactic acid, formic acid and acetic acid) from rumen bacteria. The invention also provides a novel bacterial mutant (Mannheimia sp. LPK7) having disruptions of a lactate dehydrogenase gene (ldhA), a pyruvate formate -lyase gene (plf), a phosphotransacetylase gene (pta), and a acetate kinase gene (ackA). The invention further provides a novel bacterial mutant (Mannheimia sp LPK4) having disruptions of a lactate dehydrogenase gene (ldhA), a pyruvate formate-lyase gene (pfl) and a phosphoenolpyruvate carboxylase gene (ppc) involved in the immobilization of CO2 in a metabolic pathway of producing succinic acid, and a method for producing succinic acid, which is characterized by the culture of the above mutants in anaerobic conditions. The inventive bacterial mutants have the property of producing succinic acid at high concentration while producing little or no organic acids, as compared to the prior wild-type strains of producing various organic acids. Thus, the inventive bacterial mutants are useful as strains for the industrial production of succinic acid.

REFERENCE COUNT: 6 THERE ARE 6 CITED REFERENCES AVAILABLE FOR THIS RECORD. ALL CITATIONS AVAILABLE IN THE RE FORMAT

L5 ANSWER 10 OF 17 CAPLUS COPYRIGHT 2007 ACS on STN
ACCESSION NUMBER: 2005:244598 CAPLUS
DOCUMENT NUMBER: 143:3889
TITLE: Effect of a single-gene knockout on the metabolic regulation in Escherichia coli for -lactate production

under microaerobic condition
AUTHOR(S): Zhu, Jiangfeng; Shimizu, Kazuyuki
CORPORATE SOURCE: Department of Biochemical Engineering & Science, Kyushu Institute of Technology, Iizuka, Fukuoka, 820-8502, Japan
SOURCE: Metabolic Engineering (2005), 7(2), 104-115
CODEN: MEENFM; ISSN: 1096-7176
PUBLISHER: Elsevier
DOCUMENT TYPE: Journal
LANGUAGE: English

AB The effects of several single-gene knockout mutants (pykF, ppc, pflA, pta, and adhE mutants) on the metabolic flux distribution in Escherichia coli were investigated under microaerobic condition. The intracellular metabolite concns. and enzyme activities were measured, and the metabolic flux distribution was computed to study the metabolic regulation in the cell. The pflA, pta and ppc mutants produced large amount of lactate when using glucose as a carbon source under microaerobic condition. Comparing the flux distribution and the enzyme activities in the mutants, it was shown that the lactate production was promoted by the inactivation of pyruvate formate lyase and the resulting overexpression of lactate dehydrogenase. The flux through Pta-Ack pathways and the ethanol production were limited by the available acetyl CoA. It was shown that the glycolysis was activated in pykF mutant in microaerobic culture. The glycolytic flux was related with Pyk activity except for pykF mutant. The cell growth rate was shown to be affected by the flux through phosphoenolpyruvate carboxylase. The quant. regulation anal. was made based on the deviation indexes.

REFERENCE COUNT: 42 THERE ARE 42 CITED REFERENCES AVAILABLE FOR THIS RECORD. ALL CITATIONS AVAILABLE IN THE RE FORMAT

L5 ANSWER 11 OF 17 CAPLUS COPYRIGHT 2007 ACS on STN
ACCESSION NUMBER: 2004:187103 CAPLUS
DOCUMENT NUMBER: 140:338018
TITLE: Engineering Escherichia coli for efficient conversion of glucose to pyruvate
AUTHOR(S): Causey, T. B.; Shanmugam, K. T.; Yomano, L. P.; Ingram, L. O.
CORPORATE SOURCE: Department of Microbiology and Cell Science, University of Florida, Gainesville, FL, 32611, USA
SOURCE: Proceedings of the National Academy of Sciences of the United States of America (2004), 101(8), 2235-2240
CODEN: PNASA6; ISSN: 0027-8424
PUBLISHER: National Academy of Sciences
DOCUMENT TYPE: Journal
LANGUAGE: English
OTHER SOURCE(S): CASREACT 140:338018

AB Escherichia coli TC44, a derivative of W3110, was engineered for the production of pyruvate from glucose by combining mutations to minimize ATP yield, cell growth, and CO2 production (ΔatpFH ΔadhE ΔsucA) with mutations that eliminate acetate production [poxB::FRT (FLP recognition target) ΔackA] and fermentation products (ΔfocA-pflB ΔfrdBC ΔldhA ΔadhE). In mineral salts medium containing glucose as the sole carbon source, strain TC44(ΔfocA-pflB ΔfrdBC ΔldhA ΔatpFH ΔadhE ΔsucA poxB::FRT ΔackA) converted glucose to pyruvate with a yield of 0.75 g of pyruvate per g of glucose (77.9% of theor. yield; 1.2 g of pyruvate liters-1·h-1). A maximum of 749 mM pyruvate was produced with excess glucose. Glycolytic flux was >50% faster for TC44 producing pyruvate than for the wild-type W3110 during fully aerobic metabolism The tolerance of E. coli to such drastic changes in metabolic flow and energy production implies considerable elasticity in permitted pool sizes for key metabolic intermediates such as pyruvate and acetyl-CoA. In strain TC44, pyruvate yield, pyruvate titer, and the rate of pyruvate production in mineral salts medium were equivalent or

better than previously reported for other biocatalyts (yeast and bacteria) requiring complex vitamin feeding strategies and complex nutrients. TC44 offers the potential to improve the economics of pyruvate production by reducing the costs of materials, product purification, and waste disposal.
REFERENCE COUNT: 50 THERE ARE 50 CITED REFERENCES AVAILABLE FOR THIS RECORD. ALL CITATIONS AVAILABLE IN THE RE FORMAT

L5 ANSWER 12 OF 17 CAPLUS COPYRIGHT 2007 ACS on STN
ACCESSION NUMBER: 2002:932875 CAPLUS
DOCUMENT NUMBER: 138:139948
TITLE: Genetic changes to optimize carbon partitioning between ethanol and biosynthesis in ethanologenic Escherichia coli
AUTHOR(S): Underwood, S. A.; Zhou, S.; Causey, T. B.; Yomano, L. P.; Shanmugam, K. T.; Ingram, L. O.
CORPORATE SOURCE: Department of Microbiology and Cell Science, University of Florida, Gainesville, FL, 32611, USA
SOURCE: Applied and Environmental Microbiology (2002), 68(12), 6263-6272
CODEN: AEMIDF; ISSN: 0099-2240
PUBLISHER: American Society for Microbiology
DOCUMENT TYPE: Journal
LANGUAGE: English
AB The production of ethanol from xylose by ethanologenic Escherichia coli strain KO11 was improved by adding various medium supplements (acetate, pyruvate, and acetaldehyde) that prolonged the growth phase by increasing cell yield and volumetric productivity (approx. twofold). Although added pyruvate and acetaldehyde were rapidly metabolized, the benefit of these additives continued throughout fermentation Both additives increased the levels of extracellular acetate through different mechanisms. Since acetate can be reversibly converted to acetyl CoA (acetyl-CoA) by acetate kinase and phosphotransacetylase, the increase in cell yield caused by each of the three supplements is proposed to result from an increase in the pool of acetyl-CoA. A similar benefit was obtained by inactivation of acetate kinase (ackA), reducing the production of acetate (and ATP) and sparing acetyl-CoA for biosynthetic needs. Inactivation of native E. coli alc. aldehyde dehydrogenase (adhE), which uses acetyl-CoA as an electron acceptor, had no beneficial effect on growth, which was consistent with a minor role for this enzyme during ethanol production Growth of KO11 on xylose appears to be limited by the partitioning of carbon skeletons into biosynthesis rather than the level of ATP. Changes in acetyl-CoA production and consumption provide a useful approach to modulate carbon partitioning. Together, these results demonstrate that xylose fermentation to ethanol can be improved in KO11 by redirecting small amts. of pyruvate away from fermentation products and into biosynthesis. Though negligible with respect to ethanol yield, these small changes in carbon partitioning reduced the time required to complete the fermentation of 9.1% xylose in 1% corn steep liquor medium from over 96 h to less than 72 h.
REFERENCE COUNT: 55 THERE ARE 55 CITED REFERENCES AVAILABLE FOR THIS RECORD. ALL CITATIONS AVAILABLE IN THE RE FORMAT

L5 ANSWER 13 OF 17 CAPLUS COPYRIGHT 2007 ACS on STN
ACCESSION NUMBER: 2002:295664 CAPLUS
DOCUMENT NUMBER: 137:32135
TITLE: Effects of growth mode and pyruvate carboxylase on succinic acid production by metabolically engineered strains of Escherichia coli
AUTHOR(S): Vemuri, G. N.; Eiteman, M. A.; Altman, E.
CORPORATE SOURCE: Center for Molecular BioEngineering, Department of Biological and Agricultural Engineering, University of Georgia, Athens, GA, 30602, USA
SOURCE: Applied and Environmental Microbiology (2002), 68(4),

1715-1727
CODEN: AEMIDF; ISSN: 0099-2240
PUBLISHER: American Society for Microbiology
DOCUMENT TYPE: Journal
LANGUAGE: English
AB Escherichia coli NZN111, which lacks activities for pyruvate-formate lyase and lactate dehydrogenase, and ' AFP111, a derivative which contains an addnl. mutation in ptsG (a gene encoding an enzyme of the glucose phosphotransferase system), accumulate significant levels of succinic acid (succinate) under anaerobic conditions. Plasmid pTrc99A-pyc, which expresses the Rhizobium etli pyruvate carboxylase enzyme, was introduced into both strains. We compared growth, substrate consumption, product formation, and activities of seven key enzymes (acetate kinase, fumarate reductase, glucokinase, isocitrate dehydrogenase, isocitrate lyase, phosphoenolpyruvate carboxylase, and pyruvate carboxylase) from glucose for NZN111, NZN111/pTrc99A-pyc, AFP111, and AFP111/pTrc99A-pyc under both exclusively anaerobic and dual-phase conditions (an aerobic growth phase followed by an anaerobic production phase). The highest succinate mass yield was attained with AFP111/pTrc99A-pyc under dual-phase conditions with low pyruvate carboxylase activity. Dual-phase conditions led to significant isocitrate lyase activity in both NZN111 and AFP111, while under exclusively anaerobic conditions, an absence of isocitrate lyase activity resulted in significant pyruvate accumulation. Enzyme assays indicated that under dual-phase conditions, carbon flows not only through the reductive arm of the tricarboxylic acid cycle for succinate generation but also through the glyoxylate shunt and thus provides the cells with metabolic flexibility in the formation of succinate. Significant glucokinase activity in AFP111 compared to NZN111 similarly permits increased metabolic flexibility of AFP111. The differences between the strains and the benefit of pyruvate carboxylase under both exclusively anaerobic and dual-phase conditions are discussed in light of the cellular constraint for a redox balance.
REFERENCE COUNT: 51 THERE ARE 51 CITED REFERENCES AVAILABLE FOR THIS RECORD. ALL CITATIONS AVAILABLE IN THE RE FORMAT

L5 ANSWER 14 OF 17 CAPLUS COPYRIGHT 2007 ACS on STN
ACCESSION NUMBER: 1994:650866 CAPLUS
DOCUMENT NUMBER: 121:250866
TITLE: The role of the succinate pathway in sorbitol fermentation by oral Actinomyces viscosus and Actinomyces naeslundii
AUTHOR(S): Takahashi, N.; Kalfas, S.; Yamada, T.
CORPORATE SOURCE: Department Oral Biochemistry, Tohoku University School Dentistry, Sendai, Japan
SOURCE: Oral Microbiology and Immunology (1994), 9(4), 218-23
CODEN: OMIMEE; ISSN: 0902-0055
DOCUMENT TYPE: Journal
LANGUAGE: English
AB Sorbitol fermentation by Actinomyces viscosus and Actinomyces naeslundii was studied with washed sorbitol-grown cells. The fermentation was followed by titration of acids produced at pH 7.0 under anaerobic conditions. Metabolic end-products and intracellular levels of NAD, NADH and glycolytic intermediates during the fermentation were also analyzed. Cell exts. were examined for certain enzyme activities. Bicarbonate was required for acid production from sorbitol and from a mixture of glucose and sorbitol. Malate and fumarate could also support the acid production of A. viscosus. The main end-products were succinate and lactate but not ethanol. Cell exts. showed no activities of alc. and aldehyde dehydrogenases, but they had activities of malate dehydrogenase and fumarate reductase. In the absence of bicarbonate, malate or fumarate, the intracellular NADH/NAD ratio increased and the levels of 3- and 2-phosphoglycerate and phosphoenolpyruvate decreased. The results indicate that oral

sorbitol-fermenting actinomyces lack the ethanol pathway that can contribute to NADH oxidation To maintain intracellular redox balance during anaerobic sorbitol fermentation, these bacteria can oxidize surplus NADH through a succinate pathway.